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Forecasting Employment Rates:
A Cohort Approach

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ABSTRACT

This paper examines the past and future behaviour of the employment rate in Canada using an econometric model that is estimated using administrative data on specific age-sex cohorts. The cohort approach allows us to model explicitly the extent to which people of a given age participate more or less in the labour force than those born in a previous year. We use our model to forecast employment rates over the long run. Our results suggest that the next few years will be a period of recovery in the employment rates of most categories of workers. Starting around 2005, however, the behaviour of the employment rate for men and women will diverge. The employment rate will continue to rise for female age groups but will either stay constant or slowly decline for men.

RÉSUMÉ

Dans ce travail, nous analysons le comportement passé et futur du taux d'emploi au Canada à l'aide d'un modèle économétrique estimé à partir de données administratives. L'unité d'analyse est la cohorte définie par l'âge et le sexe. L'approche à cohortes nous permet de modéliser explicitement dans quelle mesure une personne d'un âge donné participe plus ou moins au marché du travail que celle née à une date antérieure. Nos résultats montrent que la fin des années 1990 et le début de la prochaine décennie sera une période de reprise sur le marché du travail pour plusieurs catégories de travailleurs. À partir de 2005, le comportement des taux d'emploi des hommes et des femmes divergera. Le taux d'emploi continuera d'augmenter pour les différents groupes d'âge de femmes, alors qu'il demeurera constant ou déclinera pour les hommes.

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I. Introduction

The rate of growth of employment is one of the most important factors to consider when making long-run projections of economic growth for a country. Employment growth depends upon two factors: the size of the working age population; and the employment rate. While the working age population varies only according to changes in mortality rates, birth rates and immigration flows, changes in the employment rate are a function of a wider range of influences, including cyclical and structural factors and demographics. All of these factors need to be considered when attempting to model the future path of the employment rate.

This paper examines the past and future behaviour of the employment rate in Canada for all ages using an econometric model that uses data on specific age-sex cohorts. By a cohort we mean a collection of people who were born in the same year. This concept is separate and distinct from that of an 'age group,' which is a collection of people of the same age, the membership of which changes over time as people age. The members of an age group change each year, because members of the group become older and pass into another age group; however, members of a cohort always stay in that same cohort. The popular term 'generation' as in 'Baby Boomer generation', 'Generation X', etc., is a wider, more intuitive and inexact way of approaching the specificity captured by the word 'cohort.' The advantage of making the cohort the unit of analysis is that we can explicitly model *cohort effects*: the extent to which persons born in a given year tend to participate more or less in the labour market at a given age, in comparison to those born before or after. In particular, this approach allows us to model explicitly the increasing tendency for Canadian women of any given age to participate more in the labour force than their mothers or grandmothers.

The literature dealing with the prospects for employment and participation rates in Canada can be divided into two: studies that use econometric techniques to examine the behaviour of certain sections of the labour force, such as youth or women; and studies that examine the whole labour force, but which abandon econometric techniques in favour of educated guesses about the future behaviour of different age-sex groups. An example of the first approach is a paper by Beaudry and Lemieux (1999), who use a cohort approach to examine female participation rates using aggregated data from the Survey of Consumer Finances. They find that the cohort effect amongst women mentioned above is the key factor in explaining the behaviour of female participation rates in the 1990s. Examples of the second or 'educated guess' approach are studies by Ip (1998) and Sunter and Bowlby (1998), both of which conclude that much of the decline in the participation rate in the 1990s has been structural, not cyclical. However, these studies do not use a cohort approach, nor do they use the kind of econometric techniques that might allow a more precise estimate of the relative importance of structural and cyclical factors. For example, Ip argues that increased school enrolment is in large part responsible for the decline in participation by young adults. Without econometric analysis it is impossible to know what proportion of increased enrolment is simply due to young people choosing to stay in school because there are fewer opportunities for them in the labour market.

Our study differs from both the approaches mentioned above because we take an econometric approach that explicitly considers cohort effects, and we examine the whole labour force, not just specific groups.

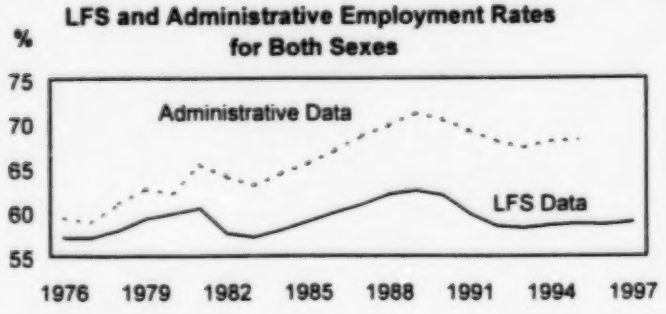
The paper is organized as follows. In Section II we describe the administrative data that we use. Section III outlines the cohort-based econometric model that we use and the parameter estimates that it yields. In Section IV, we use the econometric results of Section III to make projections of future employment rates based on alternative assumptions about various macroeconomic variables. Finally we conclude with Section V.

II. Data and Stylized Facts

1. Data

The data set we use in this paper to estimate and project employment rates is administrative data on the number of earners by sex and individual age for Canada, excluding Quebec. We use Census data on population to produce aggregated employment rates. Figure 1 contrasts these data with Labour Force Survey (LFS) data. The LFS employment rate is lower than the employment rate from administrative data throughout the period because of conceptual differences. The LFS data are for all of Canada, whereas the administrative data is for Canada excluding Quebec. The administrative data include all earners as employed people for the year, even if a person works only one week in the year. This means that the administrative concept of employment rate does not take into account the length of work of the earners. In contrast, the LFS employment rate takes into account the number of weeks people work when averaging over the year. We use the administrative data in this paper because we want to relate our forecasts of the employment rate to the Canada Pension Plan.

Figure 1



2. Specific Groups

Looking at the aggregate rates masks the trends and changes some age groups are experiencing. Here we focus on the employment rates of three age groups: a) young workers (20-24 years of age), b) prime age workers (25-54 years of age), and c) older workers (55-69 years of age).

a) Youth

Young workers have quite different characteristics from their older counterparts, in particular a much weaker labour force attachment. Also, young people today tend to stay in school significantly longer than their counterparts of 40 years ago and they are also much more likely to pursue some post-secondary education, often including university education (see Wilkins (1998)). This educational achievement affects the patterns of participation and employment rates for this category of workers. In their study on participation rates in the 1990s, Sunter and Bowbly (1998)

find that the fall in the participation rate of young people aged 15 to 24 is explained mostly (51 per cent between 1989 and 1997) by the rise in full-time school attendance. Another study on the causes of the decline in youth participation in the 1990s, by Grignon and Archambault, finds that 33 to 50 per cent of that decline is attributable to the business cycle. Their findings also indicate that a large part of the decline in youth participation rate is due to an increase in school enrolment rate and therefore is structural. However, the key question is the extent to which school enrolment rates are influenced by cyclical conditions.

Figure 2

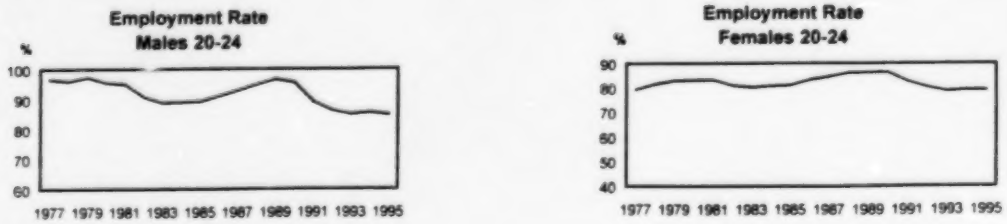
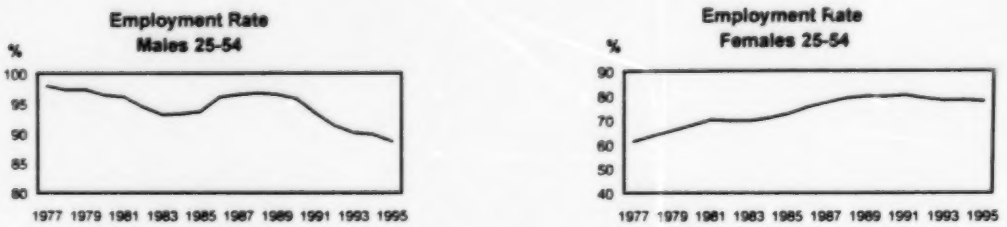


Figure 2 shows that employment rates for young men are highly cyclical. Female employment rates have also been affected by the cycle, but to a lesser extent than their male counterparts.

b) Prime-Aged Workers

Figure 3 shows employment rates for male and female prime-age workers. The impact of the recession seems to have been more important for men. In fact, employment rates for men had not even recovered their pre-1980s level when the second recession occurred in early 1990s. For women, there is a marked upward trend in employment rate that can be observed throughout the period.

Figure 3

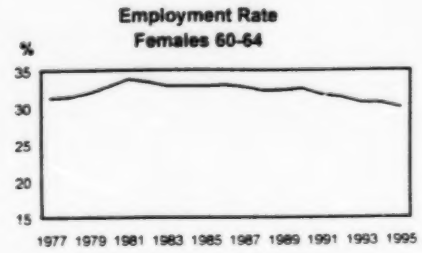


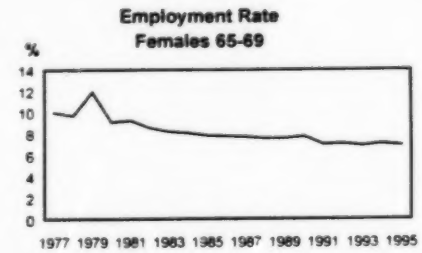
c) Older Workers

Employment rates for older men are significantly lower than they were in the 1980s and the downward trend affects all groups of older men. For older women, the employment rate is quite stable and is on an upward trend for women aged 55 to 59.

Figure 4

Figure 5





Trends in early retirement are clearly an important determinant of employment rates for older workers. Lowe (1991) takes a look at behaviour with respect to retirement and finds that the early retirement effect that we have been observing for the past 10 years might be typical of the baby-boom generation. Accordingly, we could expect the trend towards early retirement to continue for some time, but we have no indication that this will be the case for future generations to come. As with school enrolment, the key question is the extent to which early retirement is influenced by cyclical factors and the extent to which it is a longer-run phenomenon. According to Lowe, women are less likely than men to retire between the age of 55 and 64. Since before the 1990s,

employers have been offering early retirement to some employees, when possible, to reduce the need for layoffs. This is confirmed by a study from Frenken (1991) on early retirement provisions. He finds that men are more likely to take early retirement than women, which would explain, in part at least, why there is a downward trend in employment rate since the end of the 1980s for men, but not for women.

3. Economic Conditions – Labour Market

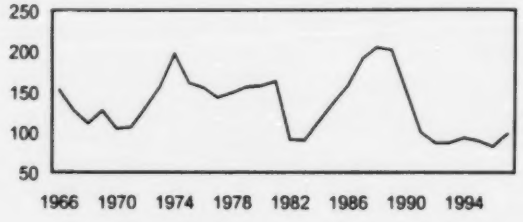
The most important influence upon the employment rate, at least in the short-to-medium term, is the state of the economy. There is no question that an important part of the decline of the employment rate in Canada in the 1990s, both in absolute terms and relative to the United States, is a result of a weaker economy (Riddell 1999). The challenge is to come up with an indicator of the state of the business cycle that is relatively exogenous to the employment rate. Using a variable such as real output is problematic because employment and output are linked via the aggregate production function. In this study we prefer to use the Job Offer Rate, which is a measure based on the Help Wanted Index that measures directly the demand for labour by employers.

a) Job Offer Rate

The Job Offer Rate is the ratio of the Help Wanted Index to the total labour force, indexed so that 1991=100. This definition follows that of Fortin (1998). The recent time series behaviour of the variable is shown in Figure 6 below. The cyclical peaks of 1974, 1981 and 1989 are readily apparent, as are the downturns in 1982 and 1991. Note the lack of a recovery in the Job Offer Rate after 1991, despite a reduction in the unemployment rate in these years. A likely explanation for this apparent contradiction is the reductions in Employment Insurance (EI) disincentives that occurred in the 1990s. These reforms have likely reduced the participation of those marginally attached to the labour force, which would reduce unemployment without much affecting the employment rate.

Figure 6

Historical Values for the Job Offer Rate



4. Economic Conditions – Asset Prices

Another potentially important influence on employment rates is asset prices. We would expect that the value of accumulated wealth will have an important income effect on the labour force participation of those approaching the age of retirement. High real interest rates and high housing

prices will increase the value of wealth accumulated for retirement, allowing people to retire earlier and lowering the employment rate. However, we would not expect the variable to have an important impact on young people, who have limited assets. We use two variables to measure the impact of changes in asset prices: the real interest rate after tax; and the relative price of housing.

a) Real Interest Rate after Tax

This variable is defined using the following formula:

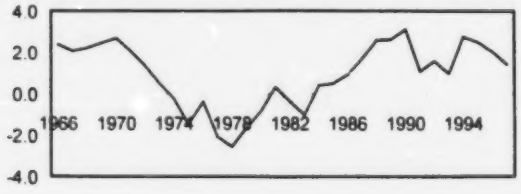
$$INT_t = 0.33 \cdot (r_t^{1yr}(1-\tau) - \pi_t) + 0.67 \cdot (r_t^{5yr}(1-\tau) - \pi_t^e)$$

where r is the nominal interest rate on government bonds; τ is the average marginal tax rate (assumed to equal 0.32); π is the rate of inflation; and π^e is the expected rate of inflation over the next five years, proxied by a moving average of inflation over the last five years.

As one can see from Figure 7, the real interest rate after tax has fluctuated quite widely over the last twenty years, becoming negative in the 1970s, as a result of high inflation, and rising again in the 1980s only to drop again in recent years.

Figure 7

Historical Values for the Real Interest Rate After Tax



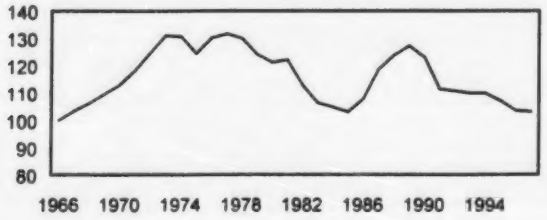
b) Consumer Price Index for Housing

Most Canadians' principal asset, apart from pension wealth, is their house. It is therefore important to have a measure of the value of this wealth relative to the price of other goods and services. We use as our measure the CPI for the replacement cost of shelter, divided by the aggregate CPI[2], and then indexed so that 1966=100. This series is depicted in Figure 8 below. Two housing price booms are apparent, one in the 1970s and another in the late 1980s. Although the causes of these booms are somewhat outside the scope of this paper, it is tempting to conclude that the entry of the baby boom cohort into ages of high housing demand is an important contributor, although low real interest rates in the 1970s were probably important as well.

[2] For the aggregate cost of shelter, we use the Cansim series number P800084 and for the aggregate CPI we use Cansim series number P800000.

Figure 8

Historical Values for the CPI for Housing



III. Estimation Model

In this section we present the cohort model that we use to estimate employment rates. In the first sub-section we explain the specification of the model, and then in sub-section two we turn to the parameter estimates. In the third sub-section we go over the cohort effects that we wish to capture with this model and explain their meaning. Finally, we present some alternative specifications for the model and discuss the robustness of the chosen specification.

1. Model Specification

Suppose the employment rate of an individual is influenced by events associated with the birth year (C), the particular year in which the employment rate is observed (Y), the age of the person at the year of observation (A), and other variables (X). We could write

$$epr = f(C, A, Y, X). \tag{1}$$

However, an identification problem would arise in estimating (1) because C, A and Y are linked by the fact that, once one knows two of the values, one can deduce the third, so that $A \equiv C - Y$. Thus, when we use A, C and Y as explanatory variables, we cannot estimate the three effects separately[3]. The way we resolve this problem is by trying to capture the year effect through variables that vary through time, but are not simply year dummies. These variables are the real interest rate after tax, the job offer rate and the consumer price index for housing. Hence, the model we use for the estimation relates the employment rate to labour market conditions, asset returns, and to cohort specific fixed effects as well as age effects. The model takes the form

$$epr = f(C, A, jor, r, p^h) \tag{2}$$

where epr is the employment rate, jor is the job offer rate, r is the real interest rate after tax and p^h is the relative consumer price index for housing. These three variables were described in section II above.

Our model therefore allows us to capture cohort, age and year effects: we believe this to be essential in any model of employment rates, because we think that all three effects have had important impacts on the employment rate over the last twenty years.

We do not use any measures of government policy as explanatory variables. However, we do not think this will bias the results. One factor that is often cited as responsible for the decrease in male participation rate is the generosity of the income support for older Canadians. Baker and Benjamin (1999) study the introduction of the early retirement provisions to Canada's public pension plans, the CPP and the QPP. They find a significant increase in the incidence of public pensions within the group of individual aged 60-64. However, they do not find evidence of effects of these changes on the behaviour of labour supply. They do find some minor adjustments in weeks worked and in weeks in the labour force. Thus they conclude that, because there is no significant effect on the labour force supply, the new provisions are not inducing men to retire early, but rather are suiting the needs of those who would not work anyway.

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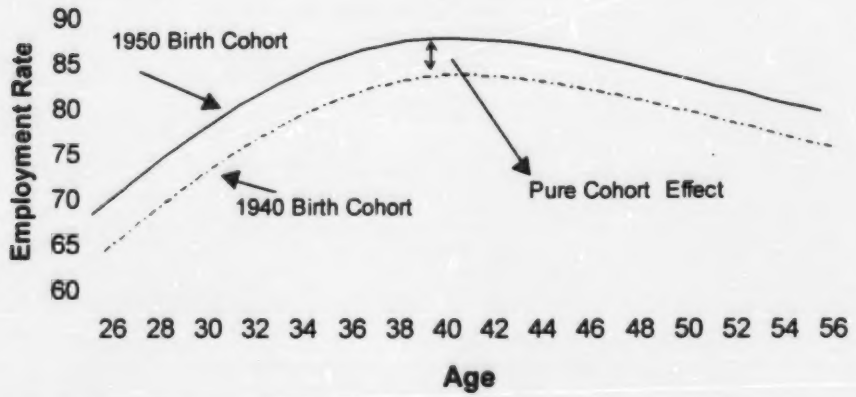
[3] We might be able to obtain identification with a non-linear specification. But in that case, the use of year dummies complicates matters, as we do not know how to forecast the dummy values.

a) Cohort Effects

We define a cohort effect as the sum of everything that is permanent, independent of the other explanatory variables, and varies by birth year. Cohort effects measure unobserved characteristics of a cohort that affect the employment rates. A positive coefficient estimate means that the entire lifetime path of employment rate of an individual lies above the entire lifetime path of employment rate of another individual (more precisely the reference individual), *ceteris paribus*. In our model, differences in a cohort's levels of personal assets such as RRSPs, private pension plans or societal attitude towards women in the workplace during a woman's adolescence could generate this kind of effect.

To illustrate what we mean by a cohort effect, suppose we have two individuals, one born in 1940 and another one born in 1950. If we look at employment rates as the individuals age, we could imagine the following pattern as shown in Figure 9 below.

Figure 9 **Hypothetical Cohort Effect**



Consider these two individuals at age 40. For the person born in 1940, this will be the calendar year 1980, and for the person born in 1950 this will be the calendar year 1990. Any difference in their employment rates that cannot be captured by other variables in the model is a *pure cohort effect*, attributable solely to the two individuals' being born in different years. The effect is, by definition, assumed to be constant over the lifetime of the members of the cohort.

b) Interaction Variables

In our model, we allow for interaction between the age variable and three other variables: the job offer rate, the real interest rate and the relative price of housing. Included in the model is a lagged dependent variable for the job offer rate. It makes more sense to have this kind of variable in a cohort model than in an age group model, because we are looking at the same group of individuals over time, rather than different individuals each year of the same age. We assume that the employment rate of cohort *c* at time *t* depends on the job offer rate *of the same cohort* at time *t*

and on the job offer rate *of the same cohort* at time *t-1*, as well as all other variables we mentioned before.

c) Specification

The specification that we estimate is the following log-linear form:

$$\overline{epr}_{c,t} = \tau_c + \theta_k age_{k,c,t} + \beta_1 jor_{t-1} \cdot age_{k,c,t} + \gamma_1 jor_t \cdot age_{k,c,t} + \eta_1 r_t \cdot age_{k,c,t} + \omega_1 p^h_t \cdot age_{k,c,t} \quad (3)$$

where $c = 1,2,\ldots,61$, $t = 1977,\ldots,1997$, $k = 1,2,\ldots,10$, $j = 1,2,\ldots,k+1$, $\overline{epr} = -\log\left(\frac{120}{epr_{c,t}} - 1\right)$.

This means that for every birth cohort we observe in our sample, we have an equation as specified by (3). We limit our attention to the birth cohorts that we observe for a minimum of 5 years in our sample. Hence, the system of equations is comprised of 61 equations, each of them with different number of observations. All the parameters are constrained to be the same across equations, except for the fixed cohort effects.

2. Parameter Estimates

We estimate (3) by OLS, accounting for the cross-equation restrictions on the parameters of the system. We report in Tables 1 and 2 in Appendix I the parameter estimates for the employment rate specification. We discuss here the main results for the job offer rate, the real interest rate after tax, the age variable and the relative price of housing. The estimates for the cohort effects for both men and women are presented and discussed in greater detail in the next section.

a) Impact of the Job Offer Rate Variable

The combined effect of present and past values of *jor* on the employment rate is positive for every age group (the only exception being for women between 45 and 54 years of age) and less important for aged 65 to 69. Younger people also seem to react quicker to a change in *jor* than do older men, so that younger people react to a change in *jor* at time *t* and older people react to a change that occurred at time *t-1*.

b) Impact of the Real Interest Rate After Tax Variable

The effect of real interest rate on the employment of men is exactly as expected. It is negative and is particularly important for older people. The effect is more or less five times more important for men aged 65-66 than for those aged 30 to 44. We find the same pattern for women: negative effect of interest rate on employment rate that becomes more important as women are approaching the retirement age.

c) Impact of the Age Variable

The age variable is a way of partly representing the experience of an individual in the labour market. Less experienced people have a weaker attachment to the labour force, so in their case we would expect the age variable to have either a small impact or a negative impact on the

employment rate. This is normal since many young people are enrolled in post-secondary education programs. For the group aged 60 to 69, we would expect a strong negative effect of age on employment rate because they would be eligible for CPP and thus more likely to retire early, and because of the normal tendency for people to retire after 60. The results show exactly these effects for both men and women. The age variables for people aged 18 or 19 have strong and negative coefficient estimates for both men and women. The coefficient estimates for the age groups 65-67 and 68-69 are again negative and very high in absolute terms, corroborating what we would expect from the beginning.

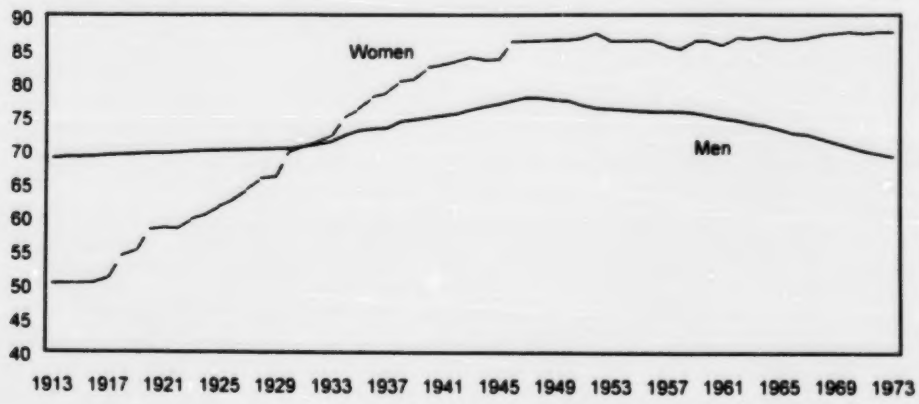
d) Relative Price of Housing Variable

We would expect from the start that the higher the relative price of housing the lower the employment rate for people close to retirement. Since a house represents an important asset for most people, the higher the price the better the financial situation is for an individual who is considering retirement. Indeed, this is precisely what the model seems to capture. The effects of the variable are negative and strong in absolute terms for men aged between 45 and 64. In fact, the coefficients are more important as people age: the coefficient is two times more important for men aged 63 to 64 than for men aged 55 to 59. For women, the coefficients are also negative, but not very important.

3. Estimated Cohort Effects

If we take the coefficient estimates for the cohort effects and transform them to obtain the values in the original space (before the log transformation), we get Figure 10 below. This figure shows how the fixed effects differ from one cohort to another, and that the fixed effects have been different for men and women. For example, if we compare the cohort effects of females born in 1941 and 1913, we can say that the 1941 cohort would have its entire lifetime path of employment rate well above the 1913 cohort, everything else being the same. The figure tells us that, for women in particular, younger cohorts will tend to participate much more in the labour market than older cohorts.

Figure 10 **Cohort Effects**



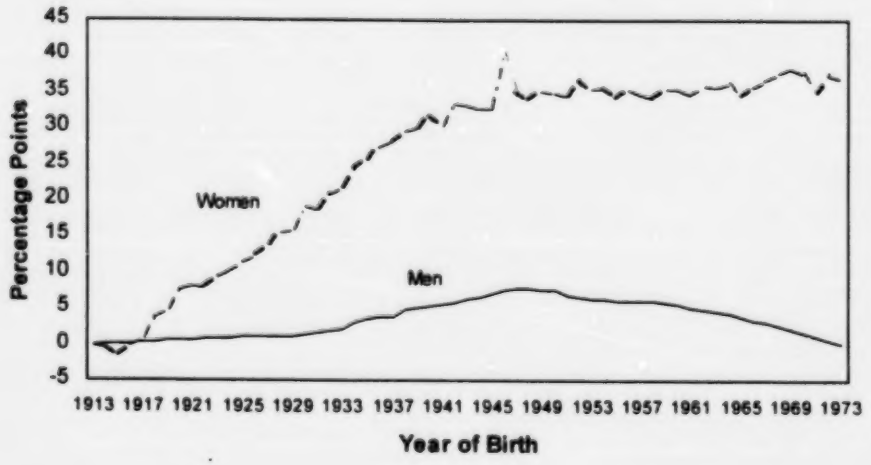
Since the absolute values on the vertical axis of Figure 10 do not have a particular meaning of themselves, we would like to know to what extent the cohort effects have an impact on each cohort's employment rate. This is shown in Figure 11 by scaling the fixed effects in relation to the 1913 birth cohort. Then we assign the same values for variables and coefficients so that the only difference in employment rates is due to differences in the fixed effects for each cohort. Then we calculate the percentage of the cohort effect in the employment rate of that cohort (again, relative to the 1913 cohort). In order to assign the same values for all the variables, we make the following assumptions:

Assumptions for Base Case Scenario:

Age:	Between 25-29 years of age
Job offer rate:	118 for 1999 (JOR 1998=107)
Real interest rate after tax:	1.7 for 1999 and 1998
CPI Housing:	109 for 1999 (106 for 1998)

The result of this exercise is shown in Figure 11, which indicates the difference in the evolution of the fixed effects for different generations of people. For the older cohort of men we see that the portion of the employment rate attributable to the fixed effect is not very big relative to the 1913 cohort (varying between 0 per cent and 9 per cent). For the cohort born after 1934, the importance of the cohort effect is greater. However, the graph also shows that, starting in 1948, there is a downward trend in the cohort effect. This means that younger cohorts tend to have less important cohort effects than those born between 1934 and 1947.

Figure 11 **Cohort Effect in Employment Rate Relative to 1913 Birth Cohort**



For women, there is clearly an upward trend in the cohort effects. The importance of the fixed effects in the employment rate of older women rose from cohort to cohort until the 1946 cohort. This may indicate a change in the attitude of women towards the labour markets. After 1946, the

value of the cohort effect tends to fluctuate around 36 percentage points (relative to the reference cohort, the 1913 birth cohort). Note that this increase in the cohort effect is still affecting employment rates because people born between 1935 and 1945 are most likely still in the labour force.

We stress that because of the non-linearities of the model, the same exercise with assumptions different from those presented in the Base Case Scenario or with other age group, will produce different results. Again, one has to be careful when interpreting the coefficient estimates for the cohort effects, and to remember to compare the values to a cohort of reference.

4. Robustness to Alternative Specifications

The alternative specifications that we estimated were variations of the log-linear equation presented above. The main differences came with the amount of interaction between exogenous variables and cohort specific fixed effects. When we included an endogenous lagged variable (employment rate in earlier period), we found no improvements on the estimation results. We also incorporated cohort effects that were interacting with the various age groups and other variable. The goodness of fit of the model was not improved with such additions.

IV. Forecasts

In this section we look at the forecasts obtained from the estimated by looking at the overall employment rate forecast. We also look at aggregate results arising from different scenarios, i.e. when we have different future values for variables such as real interest rate. Then we look at the forecasts for particular sex and age groups.

The following table presents our assumptions about future values of the variables included in the model, and the assumed future values of the cohort effects. The values that we present here are for the period 2006 to the end of the forecast. We calculate the assumed job offer rate using a Beveridge curve relationship between the unemployment rate and the job offer rate. The value we assume for the job offer rate is consistent with a gradual, non-inflationary decline in the unemployment rate to a natural rate level of six per cent. The relative CPI for housing is set to its average value over the last thirty years.[4] For the cohort effects, the future values are determined by averaging past values over a ten year period for women and by fixing the male cohort effect to its last value (which also corresponds to the lowest estimated values for all male cohorts).

Assumed Future Values

Job Offer Rate:	179
Real Interest Rate after Tax:	1.6
Real Interest Rate before Tax:	3.8
CPI for Housing:	115
Cohort Effects for Men:	68.64
Cohort Effects for women:	86.99

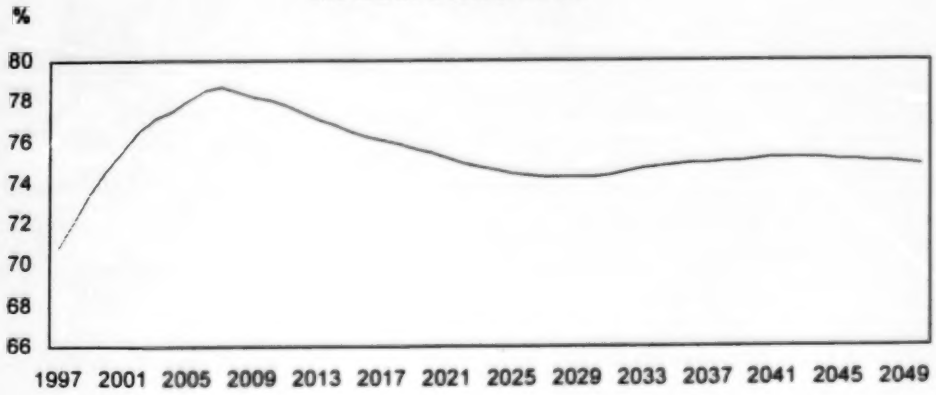
1. Aggregate Picture

We show our overall employment rate for the future in the Figure 12 below. The model predicts that the downward trend in the employment rate will begin to reverse in 1997. It will rise until 2005, and then start a slow descent that stabilizes around 2028 at a level close to 74 per cent. Continuing improvement in the economy and the cohort effects described above will increase the employment rates until around 2005. However, in the longer term, the overall employment rate will decline slowly, due mainly to changes in the demographic structure of the population.

[4] Note that this does not introduce a discontinuity in the series as the relative housing price in 1995 is close to its average value over the previous 30 years.

Figure 12

Predicted Employment Rate for Both Sexes 18-69



2. Alternative Scenarios

In order to see the impact of different assumptions about future values of the economic variables in our model, we present some alternative scenarios in this section. The first graph below represents the impact of a change in assumption about the future value of the real interest after tax on the employment rate. The base case scenario is in the middle and corresponds to a value of 1.6 per cent from 2006 onwards. On an aggregate basis for both sexes, we can see that an increase in the real interest rate after tax from 1.6 per cent to 2.3 per cent would imply a downward shift in the level of the employment rate of less than a percentage point in the long run.

Figure 13

Predicted Aggregate Employment Rate for Both Sexes, Selected Interest Rates

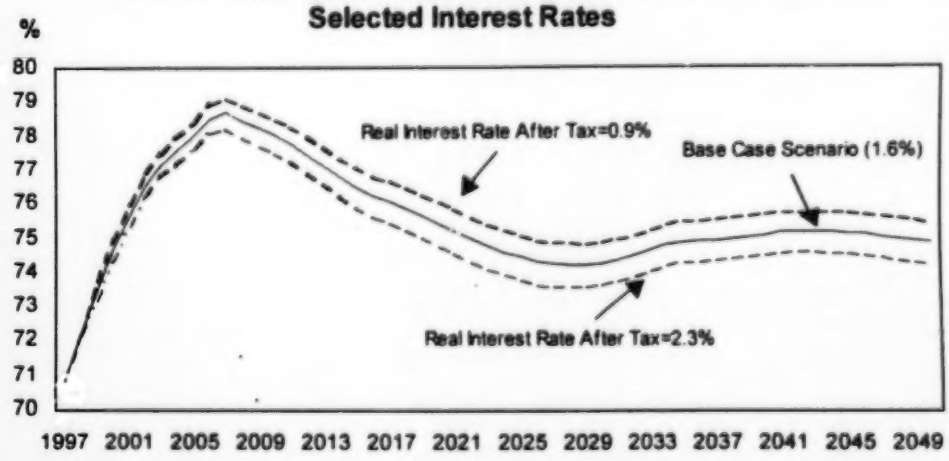
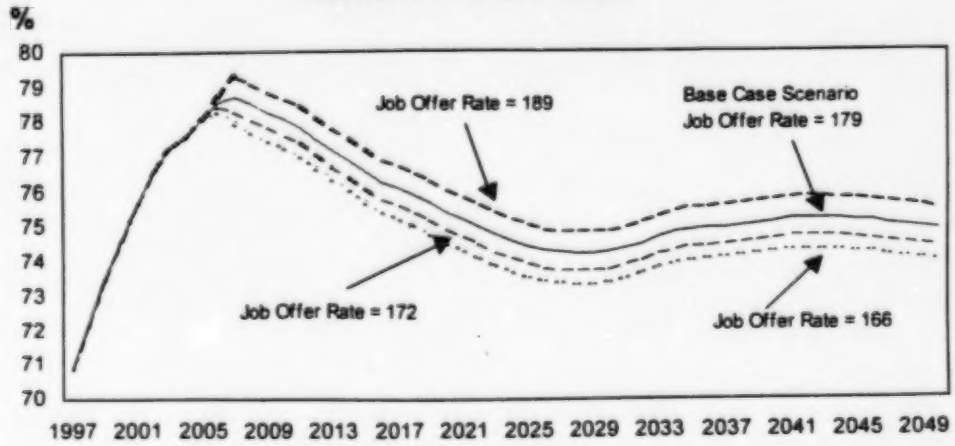


Figure 14 shows the impact of a change in the job offer rate on the employment rate. Again, the base case scenario is in the middle and corresponds to a job offer rate of 179. As before, a different assumption about the future value of the job offer rate will produce a different level for the long-term employment rate of less than a percentage point in the long run.

Figure 14 Predicted Aggregate Employment Rate for Both Sexes, Selected Job Offer Rates



If the job offer rate is 172, which is consistent with a seven per cent natural rate of unemployment, instead of 179 as in the base case scenario, then the result will be an employment rate of 74 per cent in the long run. (In other words, half a percentage point lower than the base case scenario.) If the job offer rate is assumed to be 166, which is consistent with an eight per cent natural rate, the employment rate will be 73½ per cent in the long run. If the job offer rate is 189, which is consistent with a 5 per cent natural rate, the employment rate is slightly more the 75 per cent in the long run.

3. Specific Age-Sex Groups

In this section we present the projections for three different age-sex groups: younger workers aged 20-24 and 25-29, older men aged 50-69; and older women aged 50-69. The corresponding graphs are presented in the appendix. In general terms, we can say that the next few years will be a period of recovery for most categories of workers, given the assumptions we have made. However, starting around 2005 the behaviour of the employment rate for men and women will diverge. The employment rate will still rise for female age groups, but will either stay constant or go down slowly for men.

a) Youth

Looking at the forecasts for the youth employment rate more closely, we see that although the end of the 1990s and the first decade of the new century will indeed be a period of recovery for young men, the levels for the long-term employment rate will not reach past levels. This is true for both groups of men aged 20 to 24 and 25 to 29, but it is particularly striking for the group of men aged 25 to 29. The lower employment rates for men in the long run are attributed to long-term structural changes in the behaviour of the employment rates of younger cohorts, which are captured in the model by the cohort effects. For young women, employment rates are projected to rise steadily to reach a long-term level of 84 per cent. This forecast is quite conservative, considering past trends in the variable.

b) Older Men

For older men, the behaviour of workers aged 50-59 is different from that of men aged 60-69. In fact, the employment rate for men in the early retirement age will rise until 2007 to reach a level of 93 per cent for the men aged 50-55 and of 87 per cent for those aged 55-59; after which both ratios will go down slowly. The patterns for men aged 60-64 and 65-69 are somewhat different. For men aged 60-64, the employment rate will be on an upward trend until it reaches a maximum of 69 per cent in 2010, after which the ratio will go down very slowly. The same pattern can be seen for men aged 64-69, but with a maximum value of 16 per cent in 2014. These projections are driven partly by a stronger economy, and partly by lower housing prices and interest rates. All of these factors tend to drive up the employment rates of older men.

c) Older Women

The forecasts for older women reveal very different patterns from those for older men. Since younger women today participate in the paid labour force more than today's older women did at the same age, their employment rate will be higher when this age generation gets older. The employment rates might look high at first, but they are in accordance with the fact that more young women are employed today, which will translate into a higher employment rate for older women in the future. If one takes a cohort of women born in 1949 and looks at the evolution of the employment rate over the years of their lives, the graphs show evolution in the employment rate as the cohort ages. For example, the 1949 cohort will be 59 in 2008 and have an employment rate around 70 per cent. In 2013, the same cohort will be 64 with an employment rate of 55 per cent. When this cohort turns 69 in 2018, the employment rate is only 17 per cent. The evolution of the employment rate is quite consistent with the structural change in the participation of women in the labour force. To this extent, the forecasts are not surprising at all.

Our forecasts indicate that the employment rate for women aged 50-54 will rise to its 1994 level at 76 per cent, while the employment rate for women aged 55-59 will rise until 2007 when it will reach 70 per cent. For women aged 60-64, the peak will be reached in 2011 with a 54 per cent employment rate, and for women aged 65-69 in 2015 with a 16 per cent employment rate. These results for older women are consistent with other literature, in particular with the work done by Beaudry and Lemieux (1999).

4. Employment Rate for Women over their Life Cycle

In this section we show how the estimated cohort effects affect the forecasts of employment rates, and how those forecasts look in the context of life cycle patterns for women. In section II, we argued that the appropriate way of interpreting fixed effects is not as absolute numbers, tempting though that may be, but rather as relative effects. One particular value for a cohort fixed effect is relevant only when compared to another. A higher fixed effect for the 1940 cohort compared the 1930 cohort means that, *ceteris paribus*, the entire lifetime path of employment rate of the 1940 cohort will be above the entire lifetime path of employment rate of the 1930 cohort.

In Figure 15 we show employment rates by age (actual and projected) for four birth cohorts of women. Note that we have not extracted the effects of the age and year variables to leave only the fixed effect. Instead, we choose to leave the impacts of every variable in the model. This means that all the factors influencing the various employment rates over time are reflected in the figure.

Figure 15 **Employment Rate for Women over their Life Cycle**
Selected cohorts

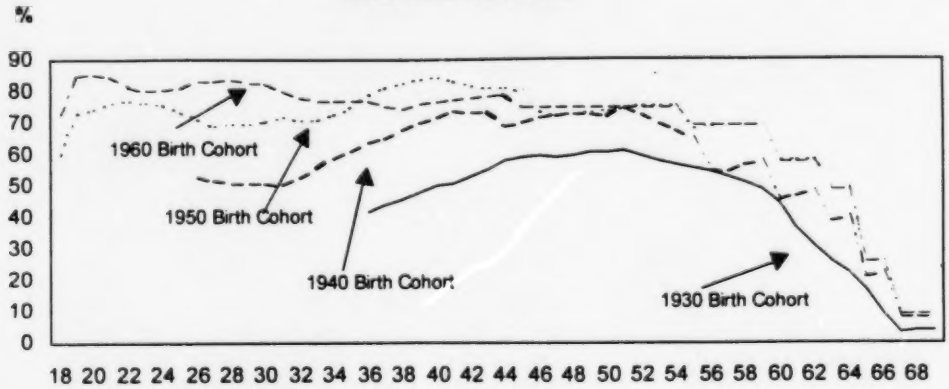


Figure 15 shows how the lifetime path of employment rate differs from one cohort to another. The 1930 cohort is the oldest for which we have plotted the evolution of its employment rate. Notably, the entire path of employment rate lies below those of the other younger cohorts. The same is true for the 1940 cohort compared the 1950 and 1960 cohorts. Clearly, part of the explanation for this lies in the cohort effect, which diminishes as new cohorts are taken into account. The reason for the diminishing importance of the cohort effects lies in the fact that the rise in the participation of women in the labour force over the last 25 years has recently reached a plateau. This means that the impact will be less pronounced among younger cohorts than it is between young and old cohorts. In fact, the 1950 and 1960 cohorts have similar patterns over the years, whereas the patterns for the 1960 cohort and the 1930 cohort are distinct.

V. Conclusions

In this paper we have modelled the behaviour of employment rates using a procedure that focuses on birth cohorts rather than age groups. This is significantly different from much of the existing literature. We believe it has important advantages. It allows us to model explicitly the difference in the behaviour of specific groups of cohorts, as opposed to generalizing about largely intuitive notions such as 'generations.' In particular, it lets us quantify the large, seemingly exogenous increase in women's employment rates over the last twenty-five years. This in turn allows us to make predictions about what older women will do in the future, based on their behaviour as younger women today. The cohort approach also allows us to capture lagged effects in employment in a more meaningful way. It seems more appropriate to relate a cohort's current employment rate to its own previous behaviour, rather to the previous experience of people of the same age but of a different cohort that faced different circumstances.

Our results show that continuing improvement in the economy will increase the employment rates of most groups, especially young people, until around 2005. This recovery will be helped for older men by lower housing prices and interest rates, assuming of course that our projections for these variables are accurate. However, in the longer term, the behaviour in the employment rate for men and women will diverge. The employment rate will still rise for female age groups but will either stay constant or slowly decline for men. The reason for this is precisely the cohort effect described above: younger women are expected to work longer when they are older than older women today, whereas men are expected to follow very much the same patterns as heretofore.

One direction for future research is to use our methodology to examine participation rates rather than employment rates, and focus on all Canada. We could also take account of two factors that we have not considered up in the present analysis. The first is the impact of the employment insurance program. The theoretical impact of EI on the employment rate is ambiguous, because although EI reduces work effort of the strongly attached, it will also encourage entry into the labour force. However, both of these effects will unambiguously increase unemployment and the participation rate. The second variable is education, which we have not considered explicitly in this paper. The education level of the Canadian population has increased significantly since 1970. Because more educated people tend to retire later, it is possible that this will increase employment rates in the future when these better-educated cohorts approach the traditional retirement age. To the extent that this varies over the working life, it will not have been picked up by the cohort effect.

Appendix I

Table 1 Parameter Estimates for the Employment-to-Population Ratio for Men Aged 18 to 69

Variable	Coefficient	Std. Error	P-Value	Variable	Coefficient	Std. Error	P-Value
1913 Cohort	0.388	0.266	0.146	JOR(t-1) *Age18	0.000	0.004	0.933
1914 Cohort	0.349	0.260	0.179	JOR(t-1) *Age19	0.000	0.003	0.930
1915 Cohort	0.214	0.254	0.401	JOR(t-1) *Age20-24	0.001	0.001	0.654
1916 Cohort	0.261	0.251	0.298	JOR(t-1) *Age25-29	0.000	0.001	0.853
1917 Cohort	0.270	0.249	0.279	JOR(t-1) *Age30-44	0.002	0.001	0.009
1918 Cohort	0.329	0.245	0.179	JOR(t-1) *Age45-54	0.003	0.001	0.000
1919 Cohort	0.367	0.242	0.130	JOR(t-1) *Age55-59	0.004	0.001	0.000
1920 Cohort	0.425	0.240	0.077	JOR(t-1) *Age60-62	0.006	0.002	0.000
1921 Cohort	0.390	0.238	0.102	JOR(t-1) *Age63-64	0.008	0.002	0.000
1922 Cohort	0.310	0.237	0.191	JOR(t-1) *Age65-66	0.005	0.002	0.008
1923 Cohort	0.321	0.234	0.172	JOR(t-1) *Age67-69	0.004	0.002	0.051
1924 Cohort	0.298	0.233	0.202	INT*Age18	-0.001	0.053	0.980
1925 Cohort	0.321	0.232	0.167	INT*Age19	0.032	0.049	0.507
1926 Cohort	0.308	0.231	0.182	INT*Age20-24	0.046	0.025	0.060
1927 Cohort	0.332	0.230	0.150	INT*Age25-29	-0.003	0.020	0.896
1928 Cohort	0.339	0.230	0.140	INT*Age30-44	-0.043	0.011	0.000
1929 Cohort	0.328	0.229	0.153	INT*Age45-54	-0.078	0.015	0.000
1930 Cohort	0.426	0.229	0.063	INT *Age55-59	-0.108	0.020	0.000
1931 Cohort	0.331	0.228	0.148	INT*Age60-62	-0.182	0.027	0.000
1932 Cohort	0.350	0.228	0.125	INT*Age63-64	-0.238	0.032	0.000
1933 Cohort	0.271	0.228	0.235	INT *Age65-66	-0.229	0.035	0.000
1934 Cohort	0.407	0.228	0.075	INT *Age67-69	-0.174	0.041	0.000
1935 Cohort	0.431	0.227	0.058	Age18	-1.204	0.950	0.205
1936 Cohort	0.412	0.226	0.068	Age19	-1.080	0.917	0.239
1937 Cohort	0.428	0.225	0.057	Age20-24	-0.544	0.468	0.245
1938 Cohort	0.553	0.223	0.014	Age25-29	-0.126	0.455	0.783
1939 Cohort	0.448	0.222	0.044	Age45-54	0.381	0.358	0.287
1940 Cohort	0.588	0.221	0.008	Age55-59	0.486	0.482	0.313
1941 Cohort	0.455	0.219	0.038	Age60-62	0.175	0.607	0.773
1942 Cohort	0.741	0.217	0.001	Age63-64	-0.080	0.738	0.914
1943 Cohort	0.557	0.217	0.011	Age65-67	-2.726	0.877	0.002
1944 Cohort	0.543	0.217	0.013	Age68-69	-3.819	0.893	0.000
1945 Cohort	0.557	0.217	0.011	JOR*Age18	0.004	0.002	0.028
1946 Cohort	1.227	0.217	0.000	JOR*Age19	0.003	0.002	0.087
1947 Cohort	0.659	0.217	0.003	JOR*Age20-24	0.002	0.001	0.026
1948 Cohort	0.543	0.216	0.012	JOR*Age25-29	0.001	0.001	0.377
1949 Cohort	0.624	0.215	0.004	JOR*Age30-44	0.001	0.000	0.089
1950 Cohort	0.589	0.215	0.006	JOR*Age45-54	0.000	0.001	0.634
1951 Cohort	0.518	0.215	0.016	JOR*Age55-59	0.000	0.001	0.849
1952 Cohort	0.720	0.215	0.001	JOR*Age60-62	0.000	0.001	0.871
1953 Cohort	0.603	0.217	0.006	JOR*Age63-64	-0.001	0.001	0.484
1954 Cohort	0.664	0.217	0.002	JOR*Age65-66	-0.003	0.002	0.067
1955 Cohort	0.551	0.219	0.012	JOR*Age67-69	-0.003	0.001	0.048
1956 Cohort	0.641	0.220	0.004	CPI_HSG*Age18	0.006	0.011	0.604

Table 1 Parameter Estimates for the Employment-to-Population Ratio for Men Aged 18 to 69

(continued)

Variable	Coefficient	Std. Error	P-Value	Variable	Coefficient	Std. Error	P-Value
1957 Cohort	0.580	0.222	0.009	CPI_HSG*Age19	0.010	0.010	0.334
1958 Cohort	0.530	0.222	0.017	CPI_HSG*Age20-24	0.008	0.005	0.074
1959 Cohort	0.586	0.223	0.009	CPI_HSG*Age25-29	0.007	0.004	0.109
1960 Cohort	0.563	0.223	0.012	CPI_HSG*Age30-44	0.004	0.002	0.085
1961 Cohort	0.487	0.224	0.030	CPI_HSG*Age45-54	-0.001	0.003	0.836
1962 Cohort	0.530	0.226	0.019	CPI_HSG*Age55-59	-0.005	0.005	0.284
1963 Cohort	0.469	0.227	0.039	CPI_HSG*Age60-62	-0.008	0.006	0.200
1964 Cohort	0.421	0.228	0.065	CPI_HSG*Age63-64	-0.010	0.007	0.173
1965 Cohort	0.299	0.229	0.192	CPI_HSG*Age65-67	0.008	0.009	0.378
1966 Cohort	0.269	0.232	0.247	CPI_HSG*Age68-69	0.006	0.009	0.486
1967 Cohort	0.260	0.233	0.266				
1968 Cohort	0.297	0.234	0.205				
1969 Cohort	0.317	0.236	0.180				
1970 Cohort	0.264	0.239	0.268				
1971 Cohort	0.146	0.243	0.549				
1972 Cohort	0.292	0.246	0.236				
1973 Cohort	0.224	0.250	0.371				

Table 2 Parameter Estimates for the Employment-to-Population Ratio for Women Aged 18 to 69

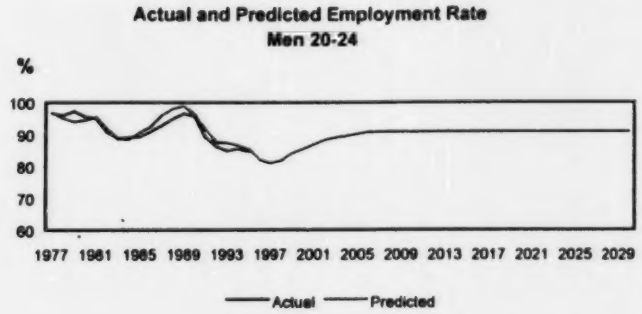
Variable	Coefficient	Std. Error	P-Value	Variable	Coefficient	Std. Error	P-Value
1913 Cohort	-0.330	0.215	0.124	JOR(t-1) *Age18	0.002	0.003	0.602
1914 Cohort	-0.341	0.209	0.104	JOR(t-1) *Age19	0.002	0.003	0.389
1915 Cohort	-0.382	0.205	0.063	JOR(t-1) *Age20-24	0.002	0.001	0.042
1916 Cohort	-0.331	0.202	0.101	JOR(t-1) *Age25-29	0.001	0.001	0.137
1917 Cohort	-0.304	0.200	0.129	JOR(t-1) *Age30-44	0.000	0.001	0.954
1918 Cohort	-0.198	0.197	0.316	JOR(t-1) *Age45-54	0.000	0.001	0.709
1919 Cohort	-0.168	0.195	0.390	JOR(t-1) *Age55-59	0.003	0.001	0.004
1920 Cohort	-0.067	0.193	0.729	JOR(t-1) *Age60-62	0.004	0.001	0.001
1921 Cohort	-0.058	0.192	0.764	JOR(t-1) *Age63-64	0.006	0.002	0.000
1922 Cohort	-0.061	0.191	0.748	JOR(t-1) *Age65-66	0.006	0.002	0.001
1923 Cohort	-0.016	0.189	0.931	JOR(t-1) *Age67-69	0.005	0.001	0.000
1924 Cohort	0.007	0.188	0.968	INT*Age18	-0.038	0.043	0.374
1925 Cohort	0.049	0.187	0.794	INT*Age19	-0.028	0.039	0.484
1926 Cohort	0.082	0.186	0.659	INT*Age20-24	-0.018	0.020	0.367
1927 Cohort	0.133	0.186	0.473	INT*Age25-29	0.046	0.016	0.005
1928 Cohort	0.189	0.185	0.309	INT*Age30-44	0.081	0.009	0.000
1929 Cohort	0.197	0.185	0.287	INT*Age45-54	0.009	0.012	0.439
1930 Cohort	0.320	0.184	0.083	INT *Age55-59	-0.062	0.016	0.000
1931 Cohort	0.305	0.184	0.097	INT*Age60-62	-0.133	0.022	0.000
1932 Cohort	0.371	0.184	0.044	INT*Age63-64	-0.180	0.026	0.000
1933 Cohort	0.407	0.184	0.027	INT *Age65-66	-0.209	0.028	0.000
1934 Cohort	0.498	0.184	0.007	INT *Age67-69	-0.206	0.033	0.000
1935 Cohort	0.546	0.183	0.003	Age18	-1.786	0.765	0.020
1936 Cohort	0.610	0.182	0.001	Age19	-1.116	0.739	0.131
1937 Cohort	0.633	0.181	0.001	Age20-24	-0.036	0.377	0.924
1938 Cohort	0.696	0.180	0.000	Age25-29	0.466	0.367	0.204
1939 Cohort	0.708	0.179	0.000	Age45-54	-0.547	0.288	0.058
1940 Cohort	0.775	0.178	0.000	Age55-59	-0.543	0.388	0.162
1941 Cohort	0.718	0.176	0.000	Age60-62	-0.758	0.489	0.122
1942 Cohort	0.853	0.175	0.000	Age63-64	-0.828	0.595	0.164
1943 Cohort	0.836	0.175	0.000	Age65-67	-2.259	0.706	0.001
1944 Cohort	0.819	0.175	0.000	Age68-69	-3.507	0.720	0.000
1945 Cohort	0.824	0.175	0.000	JOR*Age18	0.002	0.002	0.157
1946 Cohort	1.161	0.175	0.000	JOR*Age19	0.002	0.002	0.302
1947 Cohort	0.916	0.175	0.000	JOR*Age20-24	0.001	0.001	0.058
1948 Cohort	0.868	0.174	0.000	JOR*Age25-29	0.002	0.001	0.002
1949 Cohort	0.918	0.173	0.000	JOR*Age30-44	0.002	0.000	0.000
1950 Cohort	0.914	0.173	0.000	JOR*Age45-54	-0.001	0.000	0.221
1951 Cohort	0.888	0.174	0.000	JOR*Age55-59	0.000	0.001	0.850
1952 Cohort	0.983	0.174	0.000	JOR*Age60-62	-0.001	0.001	0.590
1953 Cohort	0.933	0.174	0.000	JOR*Age63-64	-0.001	0.001	0.550
1954 Cohort	0.938	0.175	0.000	JOR*Age65-66	-0.002	0.001	0.106
1955 Cohort	0.880	0.176	0.000	JOR*Age67-69	-0.002	0.001	0.040
1956 Cohort	0.934	0.177	0.000	CPI_HSG*Age18	0.005	0.009	0.561

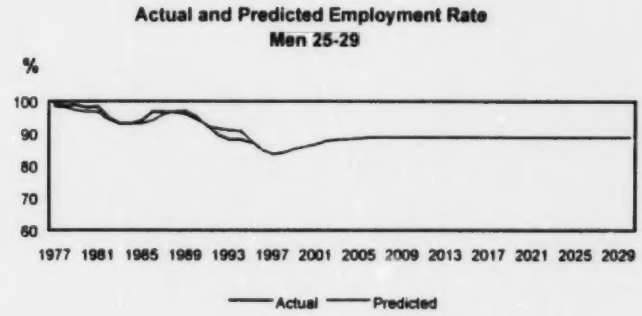
Table 2 Parameter Estimates for the Employment-to-Population Ratio for Women Aged 18 to 69

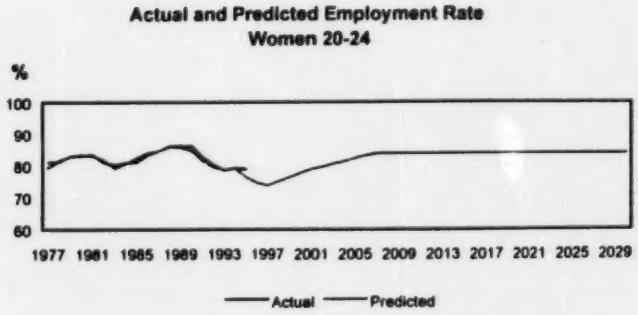
(continued)

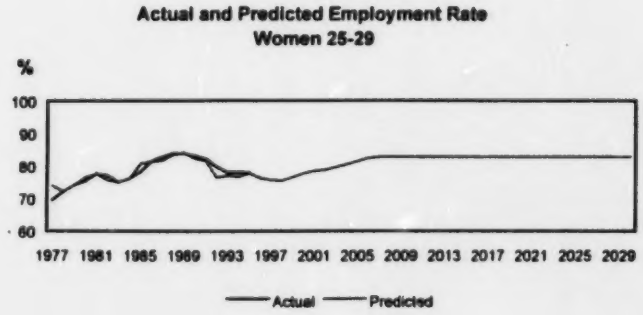
Variable	Coefficient	Std. Error	P-Value	Variable	Coefficient	Std. Error	P-Value
1957 Cohort	0.902	0.179	0.000	CPI_HSG*Age19	0.003	0.008	0.713
1958 Cohort	0.882	0.179	0.000	CPI_HSG*Age20-24	-0.005	0.004	0.148
1959 Cohort	0.933	0.180	0.000	CPI_HSG*Age25-29	-0.011	0.003	0.001
1960 Cohort	0.932	0.180	0.000	CPI_HSG*Age30-44	-0.005	0.002	0.005
1961 Cohort	0.904	0.181	0.000	CPI_HSG*Age45-54	0.002	0.002	0.327
1962 Cohort	0.952	0.182	0.000	CPI_HSG*Age55-59	-0.003	0.004	0.411
1963 Cohort	0.944	0.183	0.000	CPI_HSG*Age60-62	-0.005	0.005	0.258
1964 Cohort	0.962	0.184	0.000	CPI_HSG*Age63-64	-0.009	0.006	0.146
1965 Cohort	0.885	0.185	0.000	CPI_HSG*Age65-67	-0.002	0.007	0.832
1966 Cohort	0.940	0.187	0.000	CPI_HSG*Age68-69	0.000	0.007	0.991
1967 Cohort	0.978	0.188	0.000				
1968 Cohort	1.027	0.189	0.000				
1969 Cohort	1.055	0.190	0.000				
1970 Cohort	1.023	0.192	0.000				
1971 Cohort	0.906	0.196	0.000				
1972 Cohort	1.019	0.199	0.000				
1973 Cohort	0.989	0.202	0.000				

Appendix II
Forecasts for Specific Age-Sex Groups: Youth

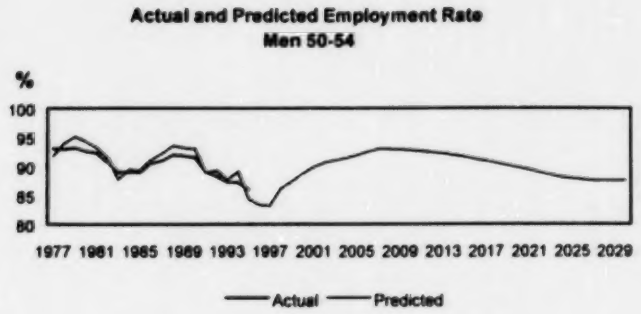


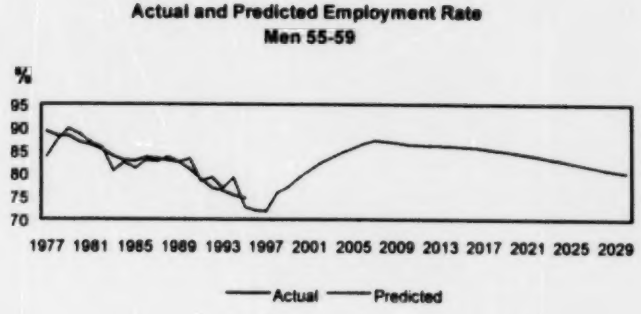


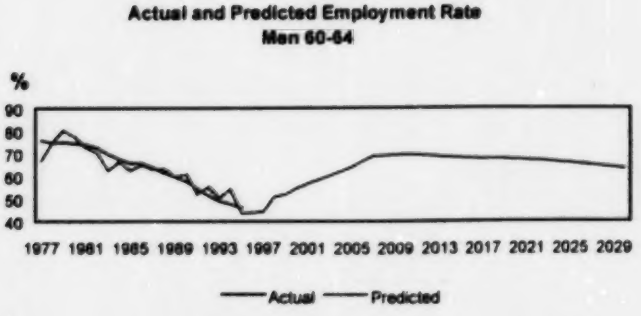


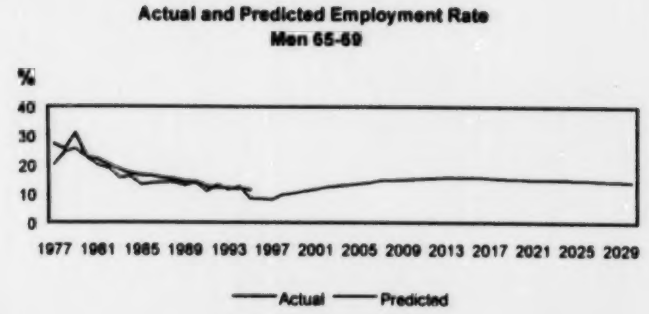


Forecasts for Specific Age-Sex Groups: Older Men

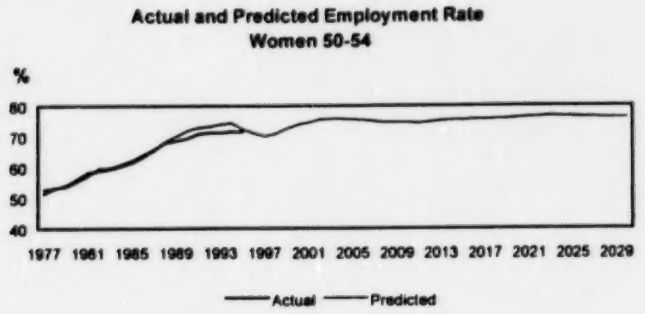


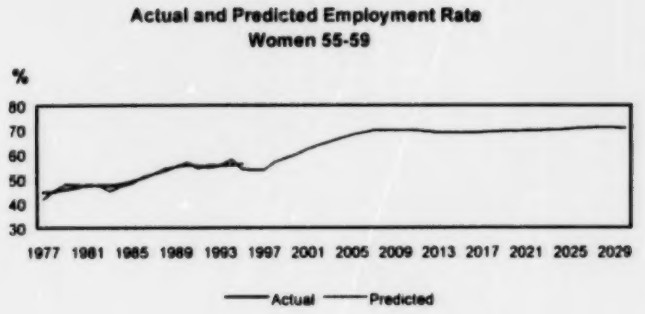


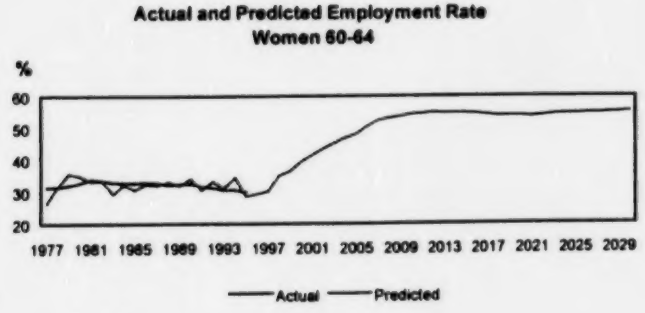


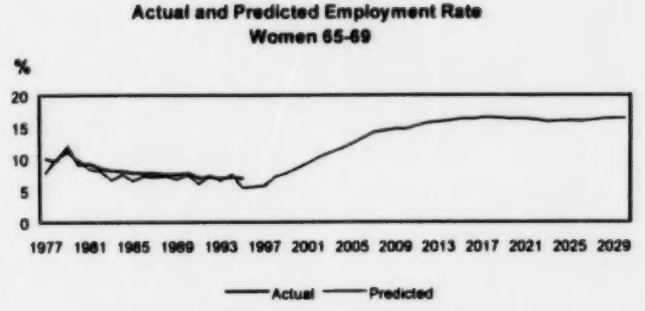


Forecasts for Specific Age-Sex Groups: Older Women









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